En Route Merging and Spacing Preparation

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Objective

- **Develop a concept of operations that utilizes advanced surveillance information and enhanced speed control to increase efficiency and capacity of merging and spacing**
  - **Facilitate Continuous Descent Arrivals (CDA)**
  - **An initial implementation of this concept of operations shall be implementable over the next few years (2010)**
  - **Concept shall also be consistent with operational evolution over longer term (2014 – 2018)**
  - **Per request of FAA Surveillance and Broadcast Services office**

Development Plan

Current demonstrations and testing

Focus of this briefing

EMSP becomes fully operational

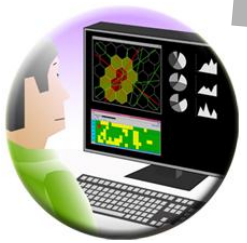
Phase	Summary Description	Performers
1	*AOC establishes spacing (ABESS)*	*Single Airline*
2	*AOC performs ABESS and then transitions flights into FDMS*	*Single Airline*
3	AOC performs ABESS and FDMS for multiple merge streams and then transitions flights to FDMS	Single Airline
4	ATC implements a master schedule: En Route Merging and Spacing Preparation (**EMSP**) and then transitions flights to FDMS (optional) • Step I –Single Merge Stream • Step II – Multiple Merge Streams • Step III – Automated Resolutions	Multiple Airlines & ATC
5	ATC implements a collaborative master schedule with multiple airlines and then transitions flights to FDMS (optional)	Multiple Airlines & ATC
6	Operations are expanded to all major airports and implemented in NAS	Multiple Airlines & ATC

Overview of EMSP

Pre-Freeze Metering Schedule for Airline

Frozen Master Metering Schedule for ATC

TFM - EMSP



- Speed Advisories issued to aircraft
- Indicated Air Speeds

AOC - ABESS

ATC - EMSP

- Clearances
- Instructions for FDMS transition (full implementation)

- Speed Advisories during en route phase of flight
- Instructions for FDMS transition (initial implementation only)

FDMS Initiation

Speed Advisories

Flight Crew

FDMS

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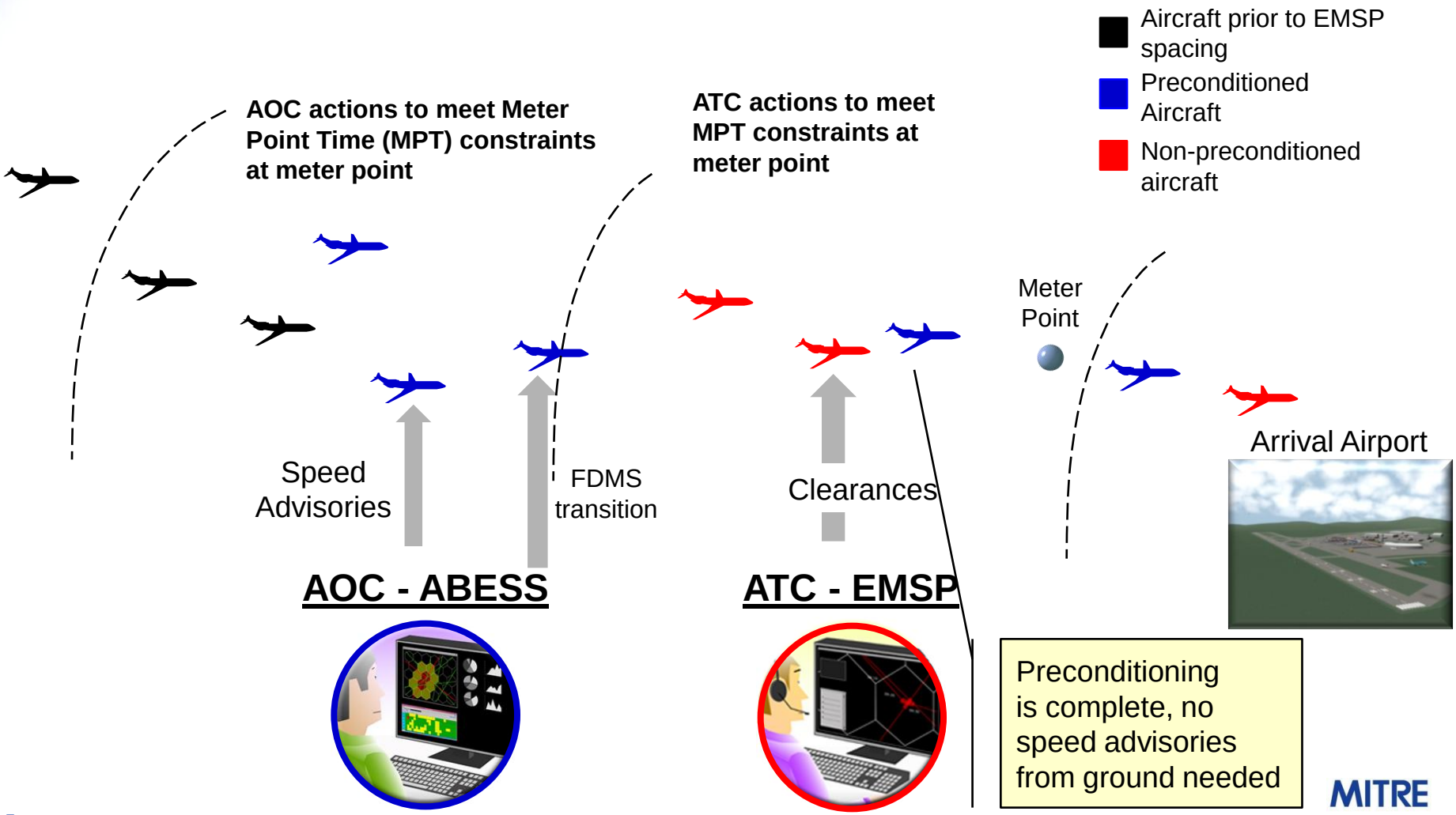
Overview of EMSP (concluded)



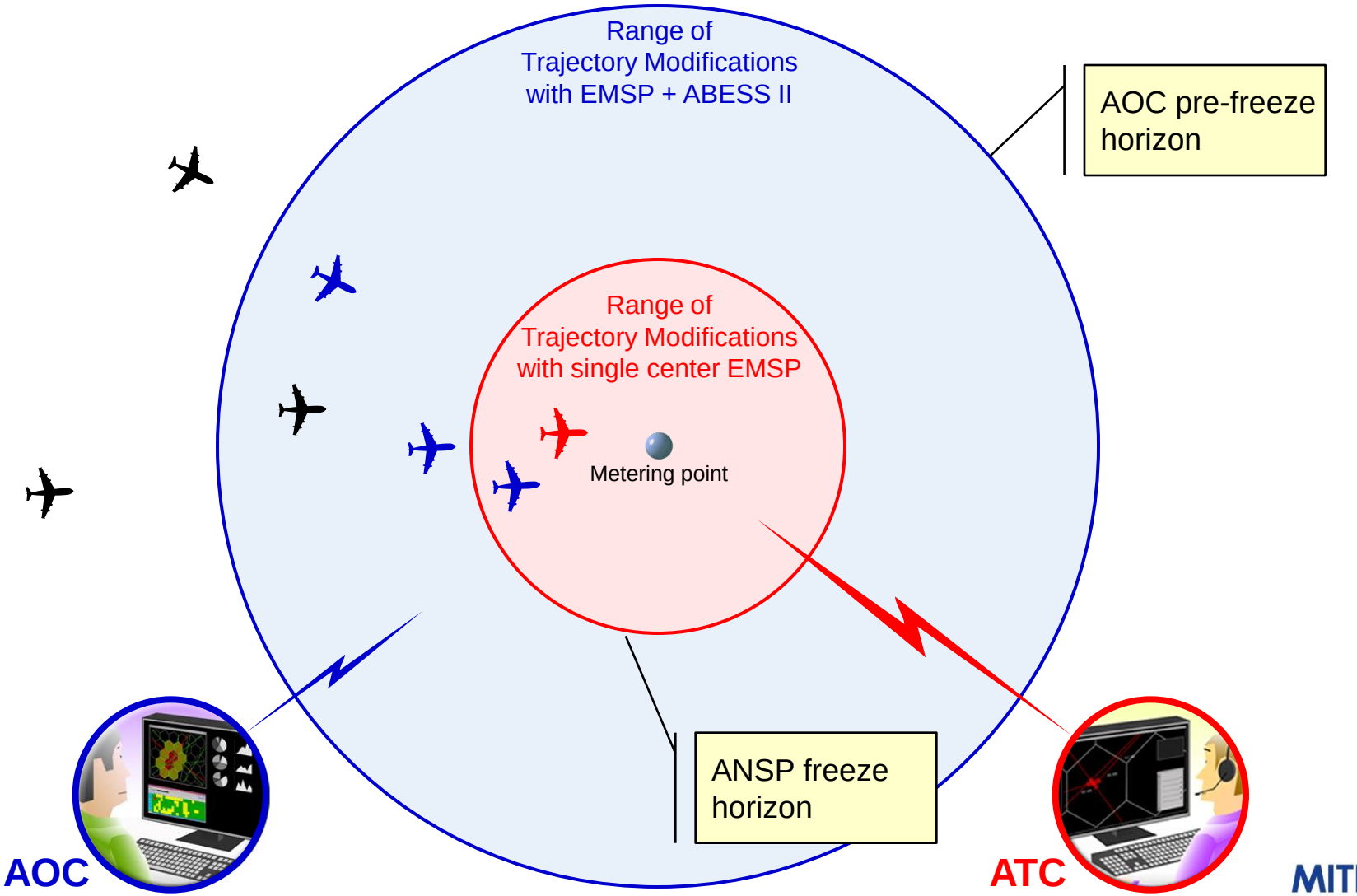
Reasons for AOC involvement

- Early speed advisories should remove requirement of later path-lengthening
  - Expected reduction in fuel burn
  - Expected reduction in controller workload for merge
- Increase TMA effectiveness by improving flow fluidity
  - Flights are preconditioned, requiring less severe adjustments by ATC
- Utilize readily available “indicated airspeed” information via ACARS for speed advisories
- Facilitate early ADS-B benefits without intended changes in TMA and controller responsibility
- Could be conducted in single-airline environment / low traffic environment without need for TMA
  - Facilitate CDA conduct that frequently requires different spacing prior to initiation than “conventional” approaches

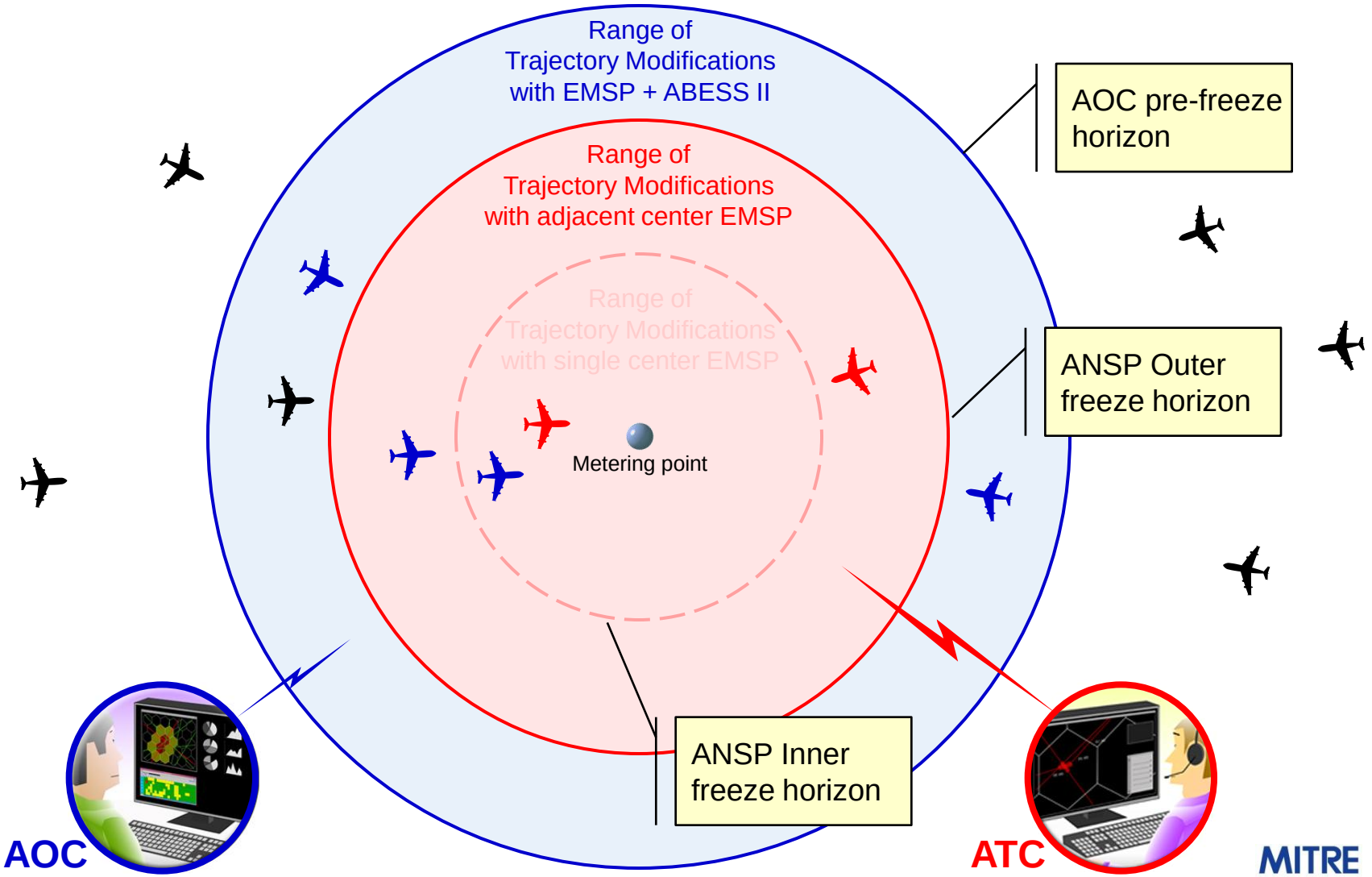
EMSP Steps

	Step I –Single Merge Stream	*Step II –Multiple Merge Streams*	*Step III – Automated Resolutions*
TFM	**Develops metering schedule for traffic in single Center**	*Develops metering schedule for traffic in **multiple Centers***	
ATC	**Controller defines and communicates maneuvers to meet metering schedule (shorter lead-times)**		*Automation generates resolutions and transitions flights into FDMS*
AOC	**Defines and uplinks speed advisories to meet metering schedule for their own fleet (longer lead-times) and transitions flights to FDMS**		*May still uplink advisories in single airline environments*
Flight Deck	**Follows spacing guidance and transition to FDMS as needed**	*Advanced FDMS capability for multiple merge streams*	
TMA	**En Route Departure Capability**	*Adjacent Center Metering*	*Additional requirements*
Est. Time	**2010**	*2014*	*2015 - 2018*

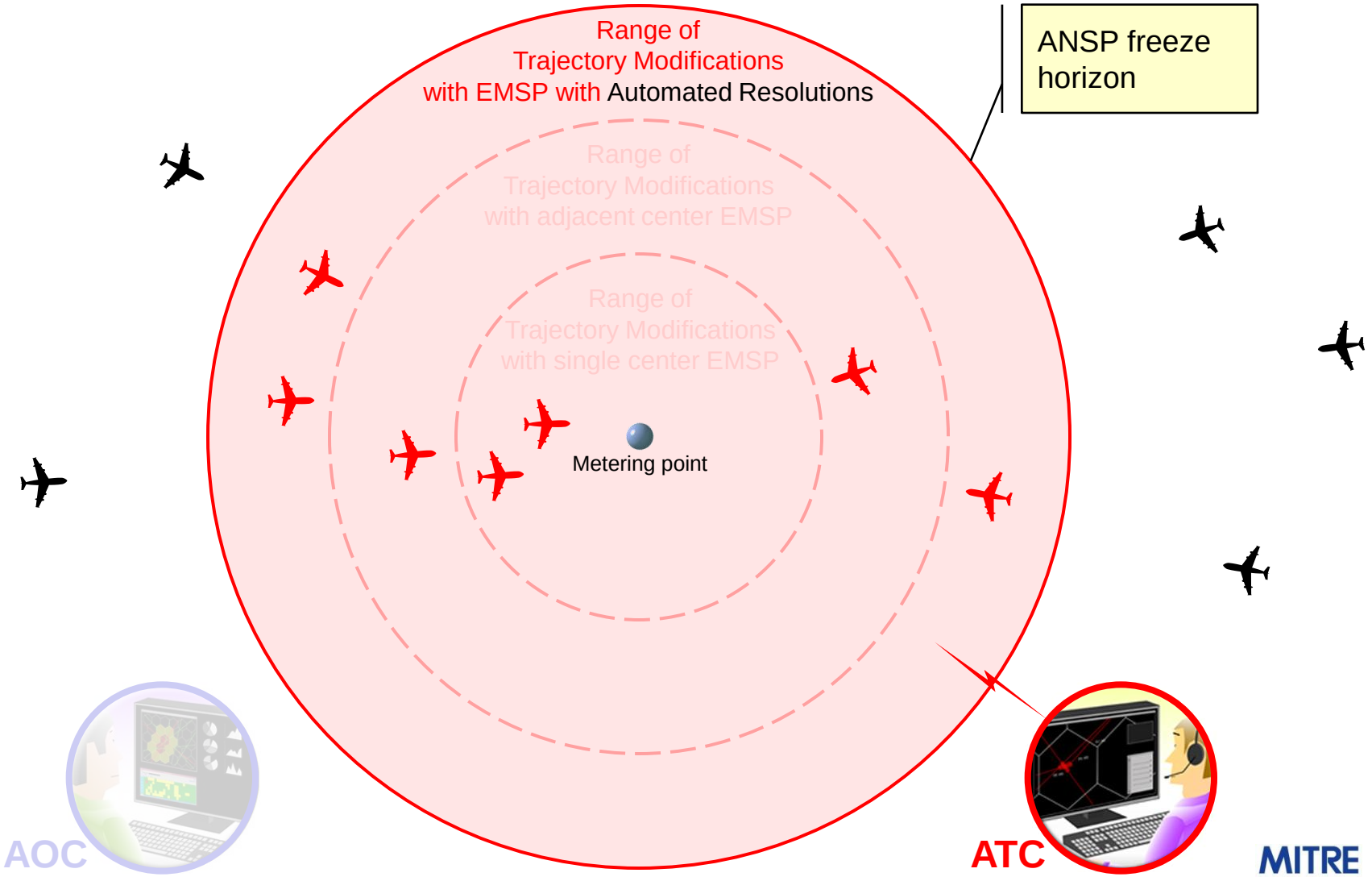
Range of Control Actions – Step I



Range of Control Actions – Step II



Range of Control Actions – Step III



ANSP Metering Capability

- The EMSP concept requires a time-based metering capability
  - ANSP makes pre-freeze metering times available to the AOCs who may calculate speed advisories to prepare spacing at meter point
  - Long distance trajectory predictions
- Traffic Management Advisor (TMA) is tool of choice
  - Implemented at all ANSP facilities
  - Currently provides functionality similar to EMSP
- For later EMSP steps, modifications will be required

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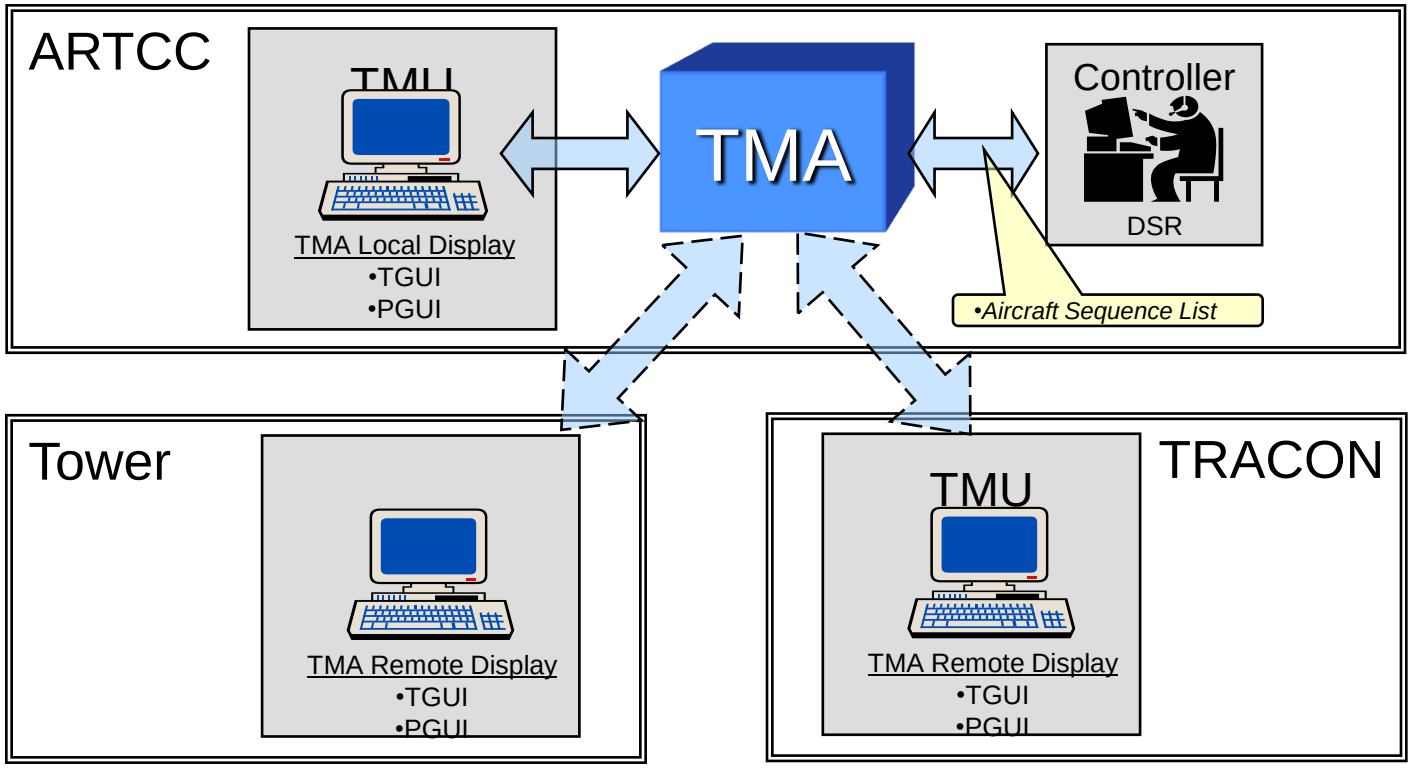
TMA Overview

– **TMA provides a common situational view among ANSP organizations: ARTCC, TRACON, and Tower**



Source: Traffic Management Advisory: FAA (2007)

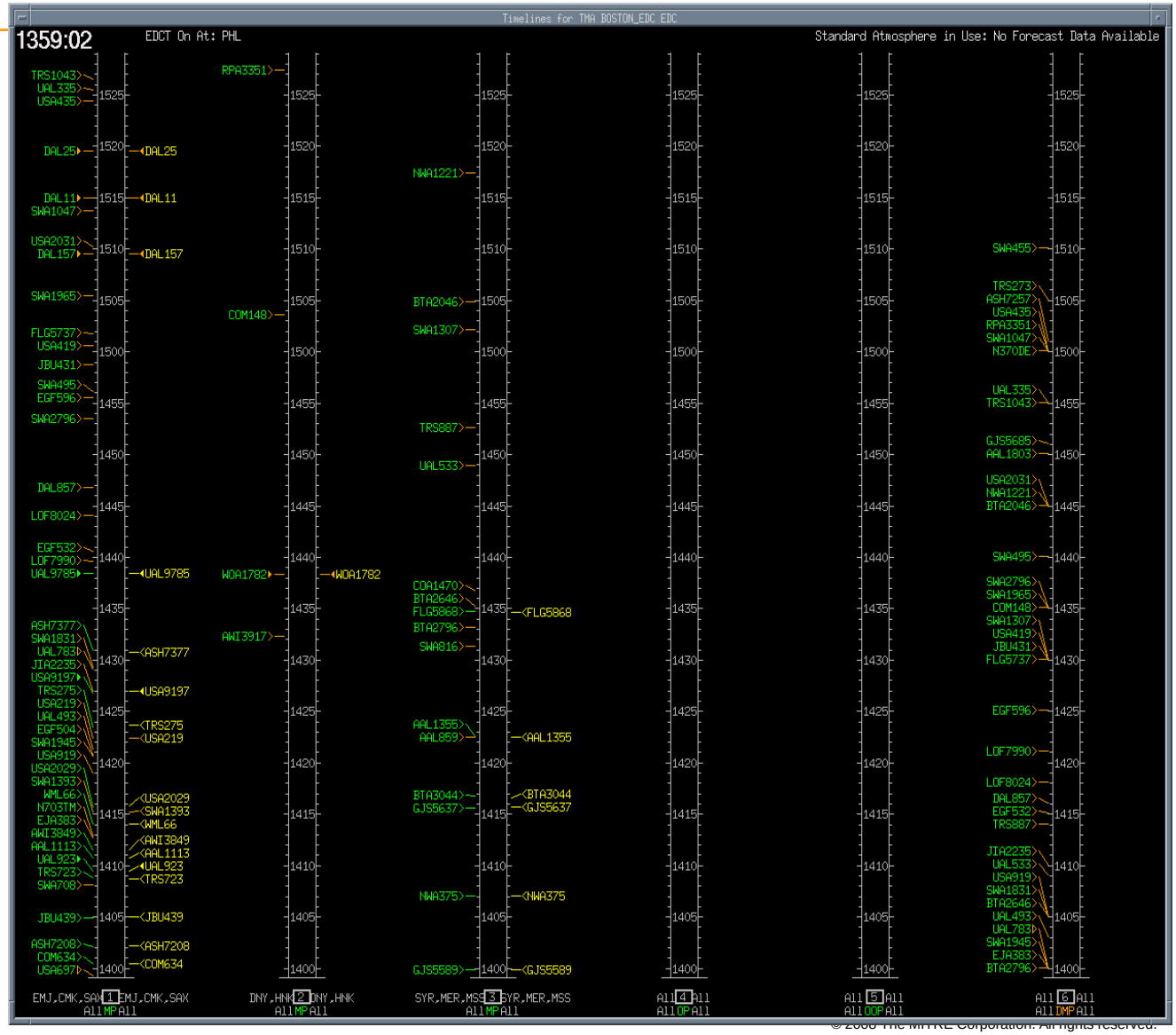
TMA - Time-Based Metering

- **Enables controllers to apply metering times to manage the flow of aircraft through congested areas**
  - **Controllers maneuver aircraft to meet TMA-assigned Scheduled Times of Arrival using the time info displayed in the Meter List (shown in green in the middle of the scope).**

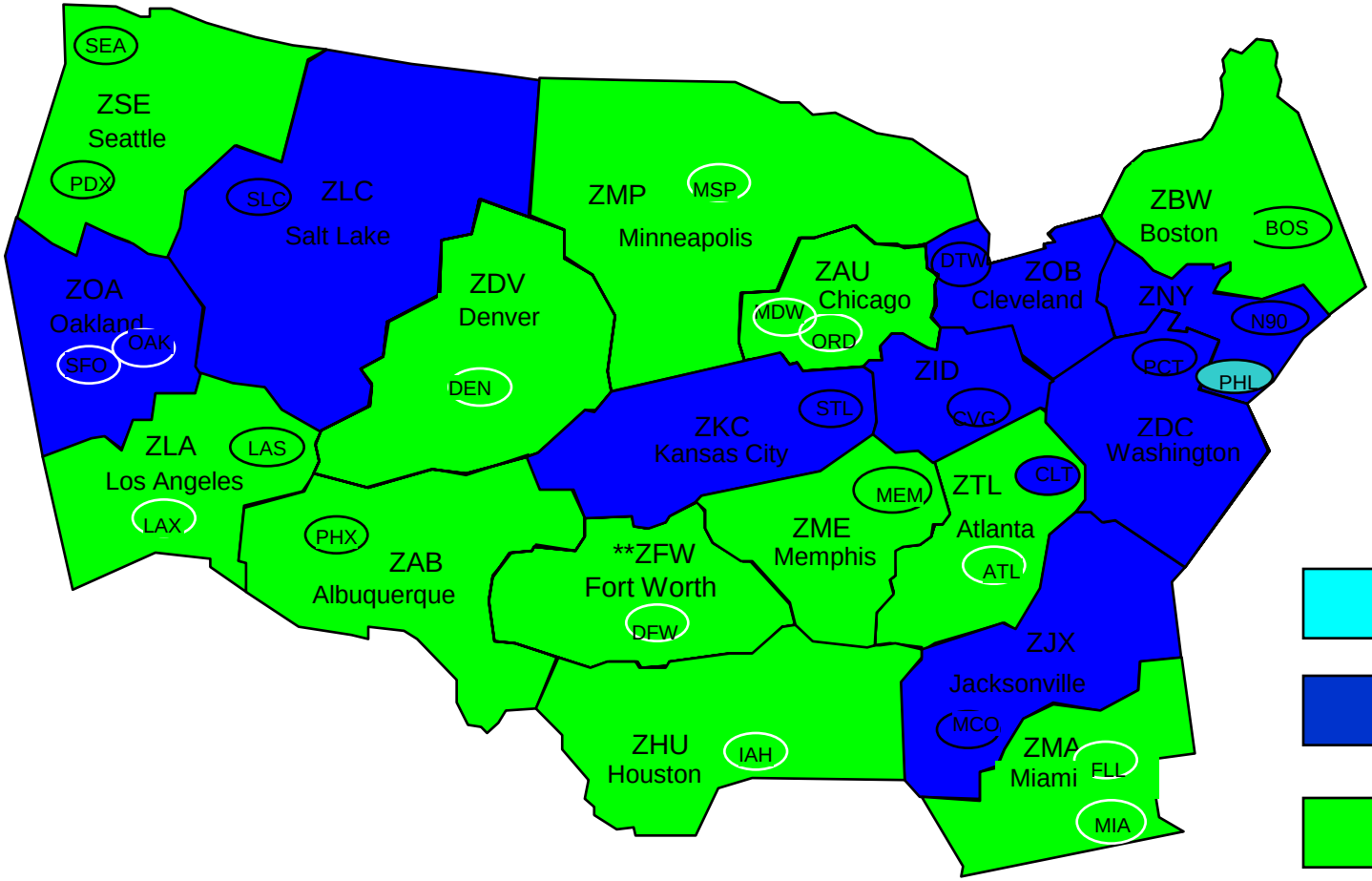
Source: Traffic Management Advisory: FAA (2007)

TMA Timeline

- TMA depicts suggested schedules on a timeline display which can show Estimated Time of Departure and Scheduled Time of Departure. It also displays Estimated Time of Arrival and Scheduled Time of Arrival to assigned Meter Points and associated arcs.



TMA Deployment Status (as of 2007)



IDU: Initial Daily Use

Source: Traffic Management Advisory: FAA (2007)

Main Research Issues

No	Description	Approach to resolve
1	EMSP pre-freeze horizons for the AOC significantly extend current TMA freeze-horizons. Is this extension feasible, what are the draw-backs?	Analysis, literature review
2	What are ATC information requirements about AOC speed advisories?	Operational experts, HITL* simulation
3	What are the benefits of early AOC speed advisories (e.g., reduced controller workload, customer flight benefits)?	Benefits analysis
4	What are ATC display requirements for EMSP Steps I, II, and III?	Design
5	Establish feasibility and develop algorithm for multi merge stream FDMS	Design, simulation

* Human-in-the-Loop

Main Implementation Issues

No	Description	Approach to resolve
1	Determine feasibility of bi-directional data-feed between TMA and AOC.	FAA / CSC TMA development groups
2	Considerations and strategies for merging ABESS traffic with other traffic.	Operational experts, HITL simulation
3	At what field-site should EMSP Step I test be conducted?	Operational experts, FAA / CSC TMA development groups
4	What are the adaptation requirements for TMA ?	FAA / CSC TMA development groups

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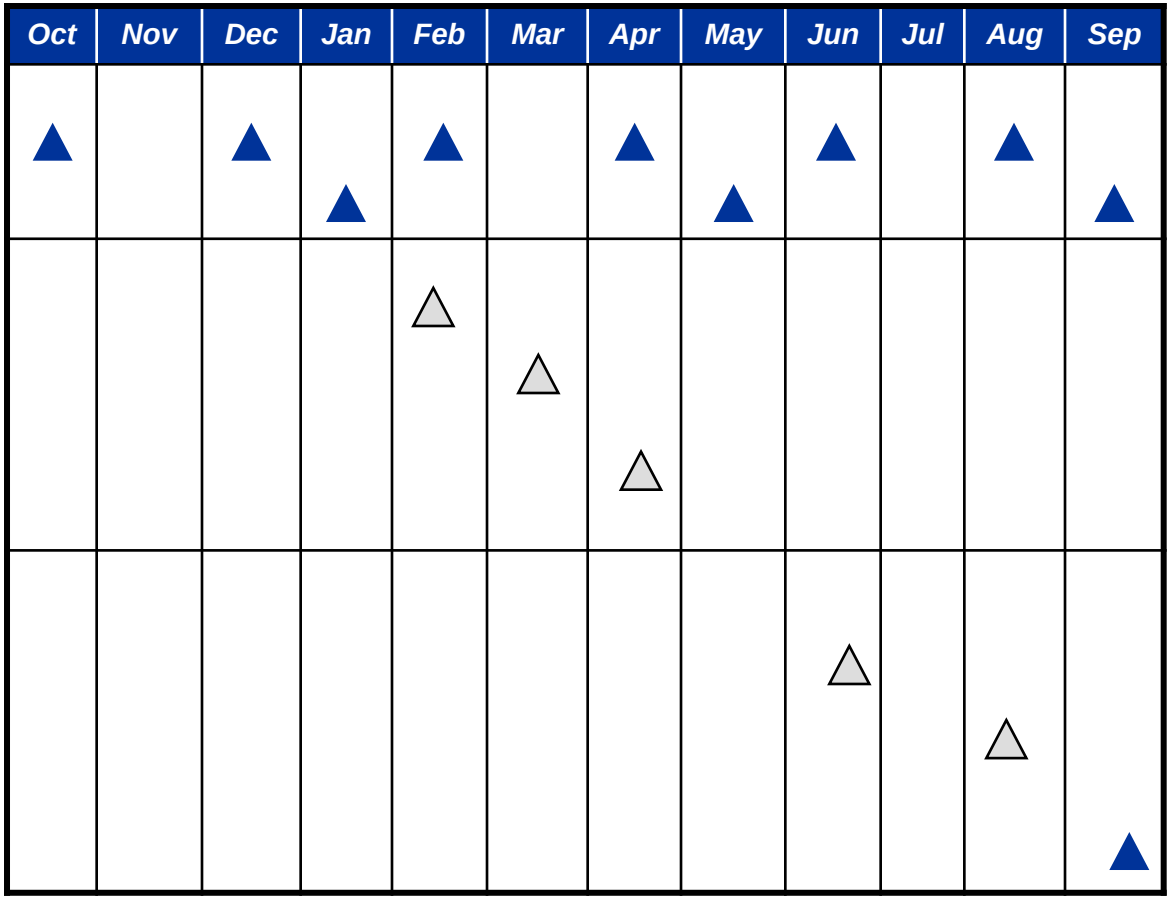
EMSP Phase 4
Concept Development Plan

- Meetings
  - EMSP focus group
  - FAA SBS
- Draft concept
  - Focus group review
  - Peer/management review
  - Draft available to FAA SBS for review
- Revised concept
  - Focus group review
  - Peer/management review
  - Coordination draft delivered



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Next Meeting Schedule
Proposed

- **November 18 - 19: Visit of ATL TMA**
- **December 16 – EMSP focus group meeting**
- **January 21 – EMSP – FAA SBS meeting**

Next Steps

- **Goal: Field-demonstration of EMSP Step I in FY 2010**
  - **Likely candidate: ZKC-center**
- **Mature concept of operations document**
- **Develop collection of research issues**
- **Develop methodology to address research issues (e.g. human-in-the-loop and fast-time simulations)**
- **Work with ANSP facilities to implement required ground-infrastructure**

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EMSP Step I

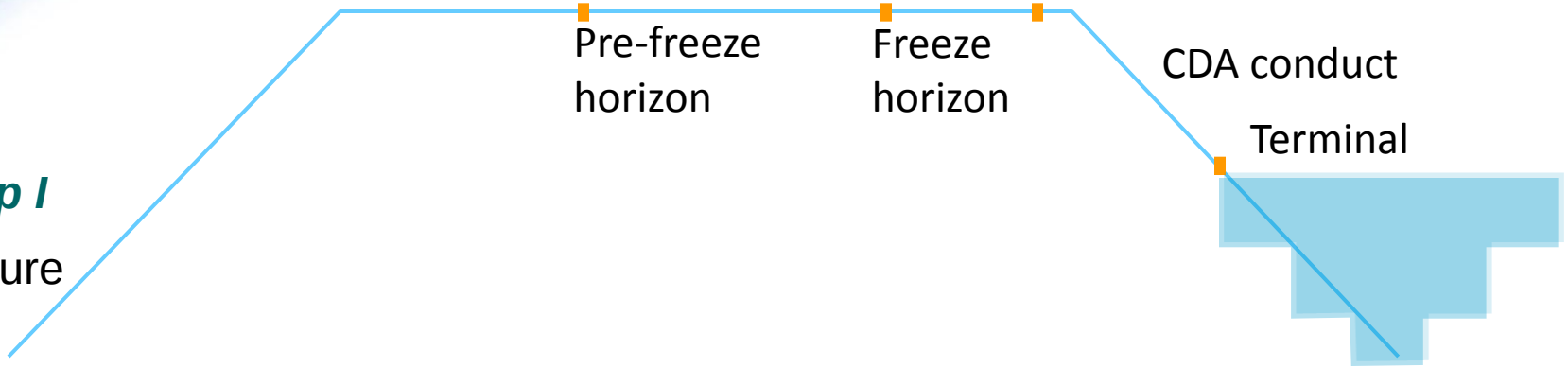
SAMPLE SCENARIO

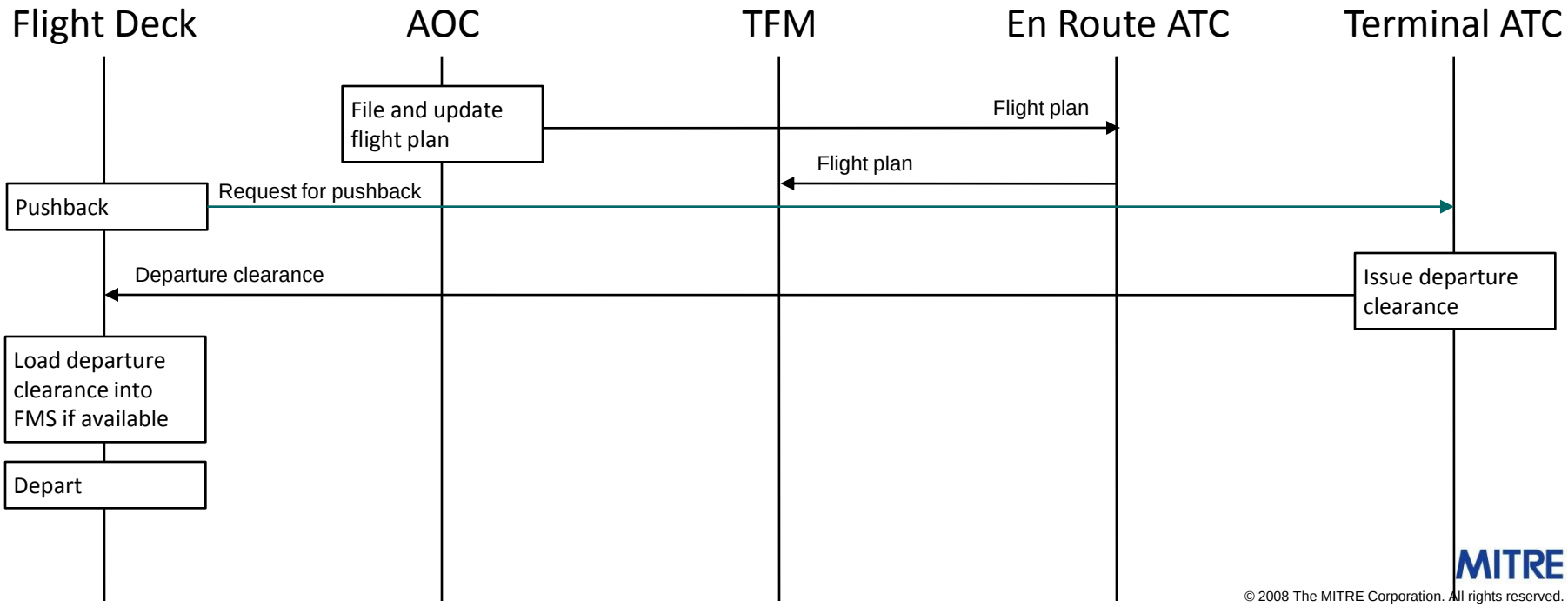
Operating Environment Assumptions

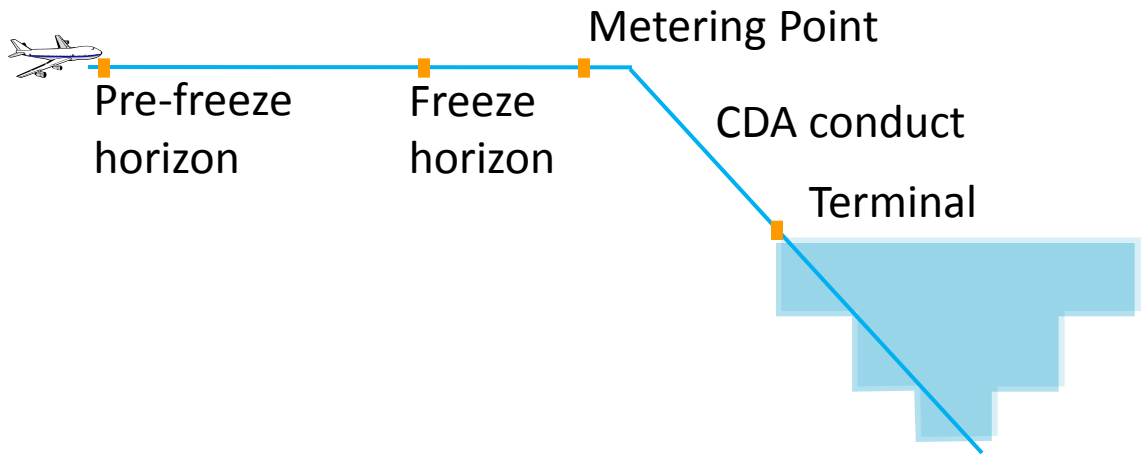
	EMSP Step I (2010)	EMSP Step II (2014)	EMSP Step III (2015-2018)
Airspace	Single stream in en route and terminal airspace for arrival flows (e.g. SDF?)	Multiple streams in en route and terminal airspace for arrival flows	
Comm-unications	AOC-to-pilot – Aircraft Communications Addressing and Reporting System (ACARS) and voice		
	Controller-to-pilot – voice	Controller/pilot – air-ground data communications and voice	
	AOC-to-ATC – voice (or fax/electronic mail)	AOC-to-ATC – ground-ground data communications and voice	
Navigation	Some aircraft Area Navigation (RNAV) capable		Most aircraft RNAV capable • Required at or above FL 180 • Required for OEP airport arrivals/departures
	Few aircraft Required Navigation Performance (RNP) capable		Some aircraft RNP capable • RNP-2 required at and above FL 290
Surveillance	Automatic Dependent Surveillance-Broadcast (ADS-B) required for FDMS operations		

EMSP Step I

Pre-departure

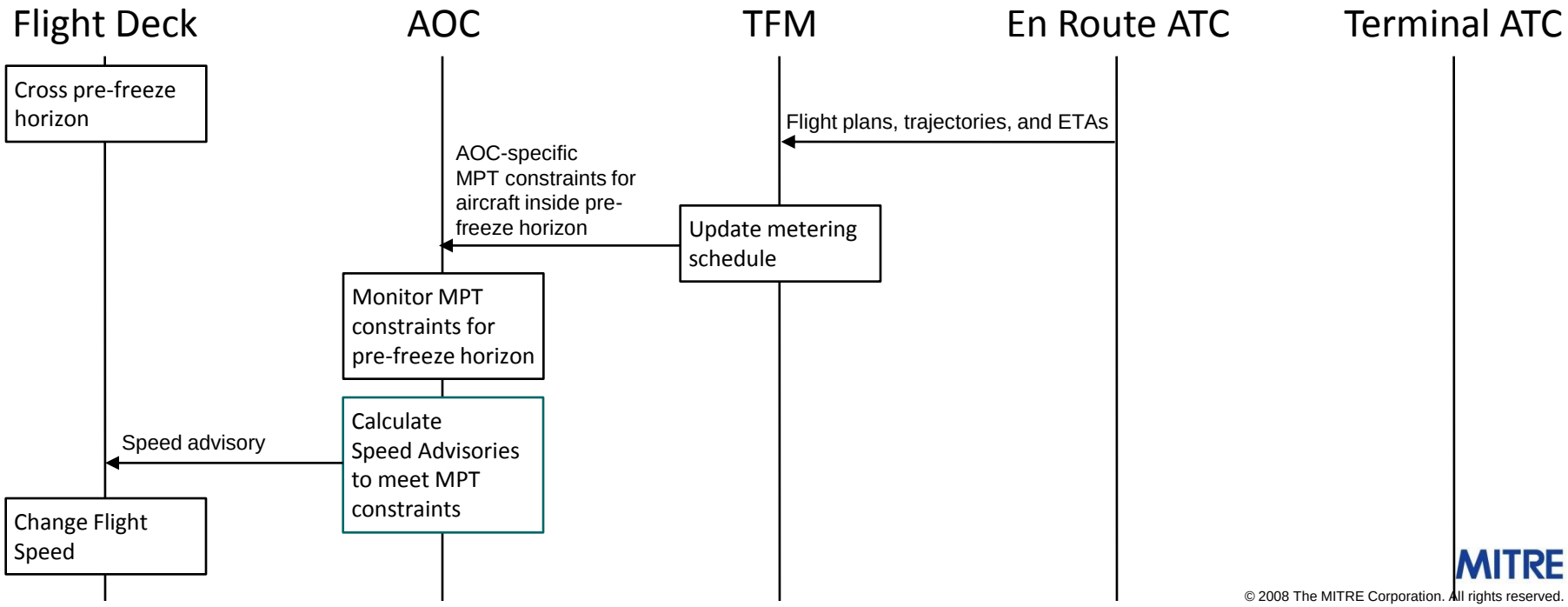


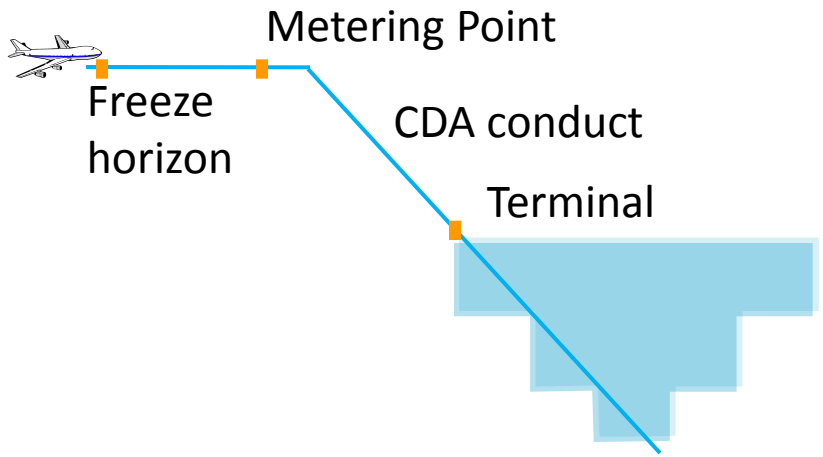




EMSP Step I

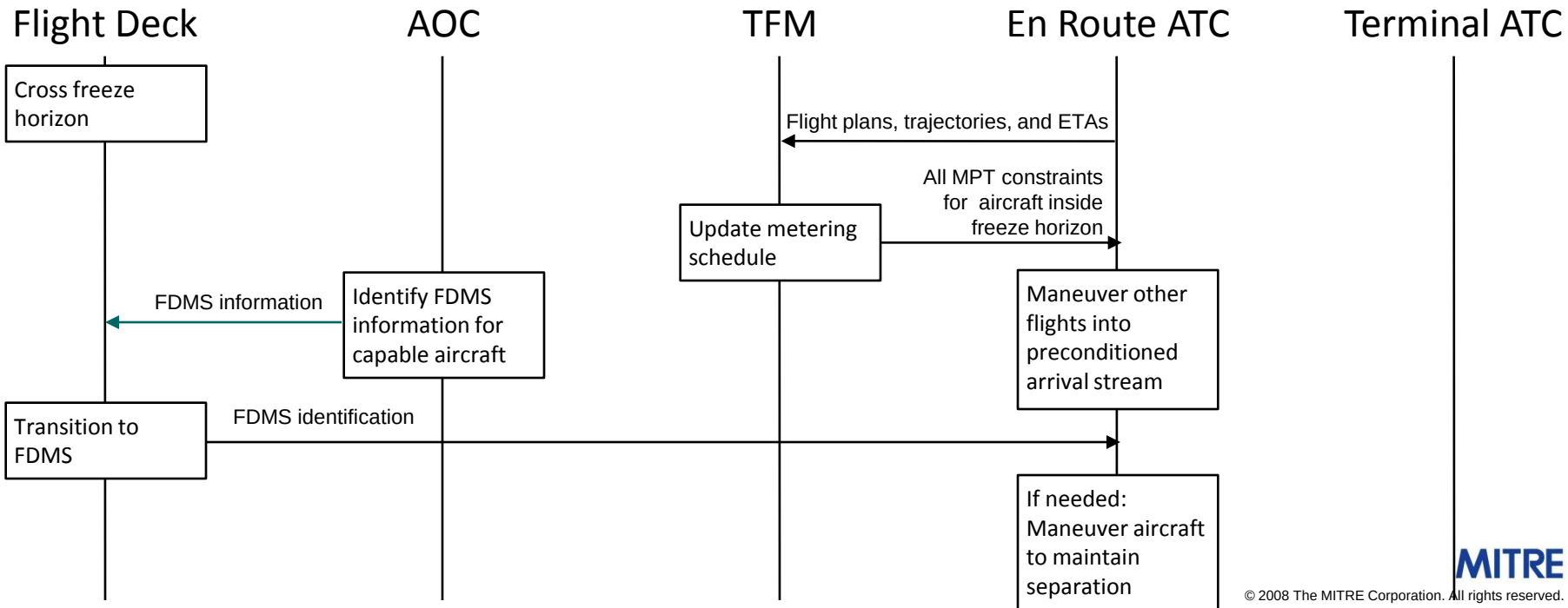
En Route – Pre-Freeze

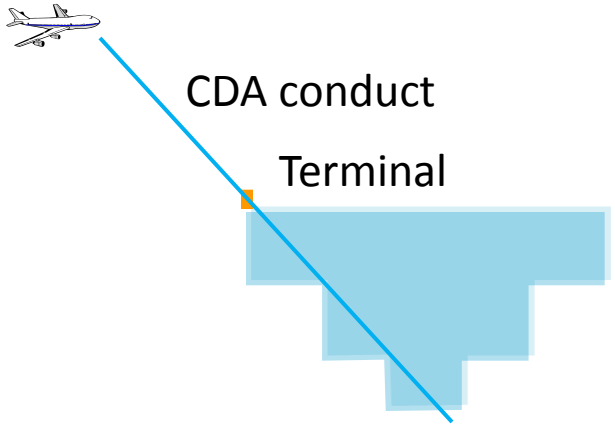




EMSP Step I

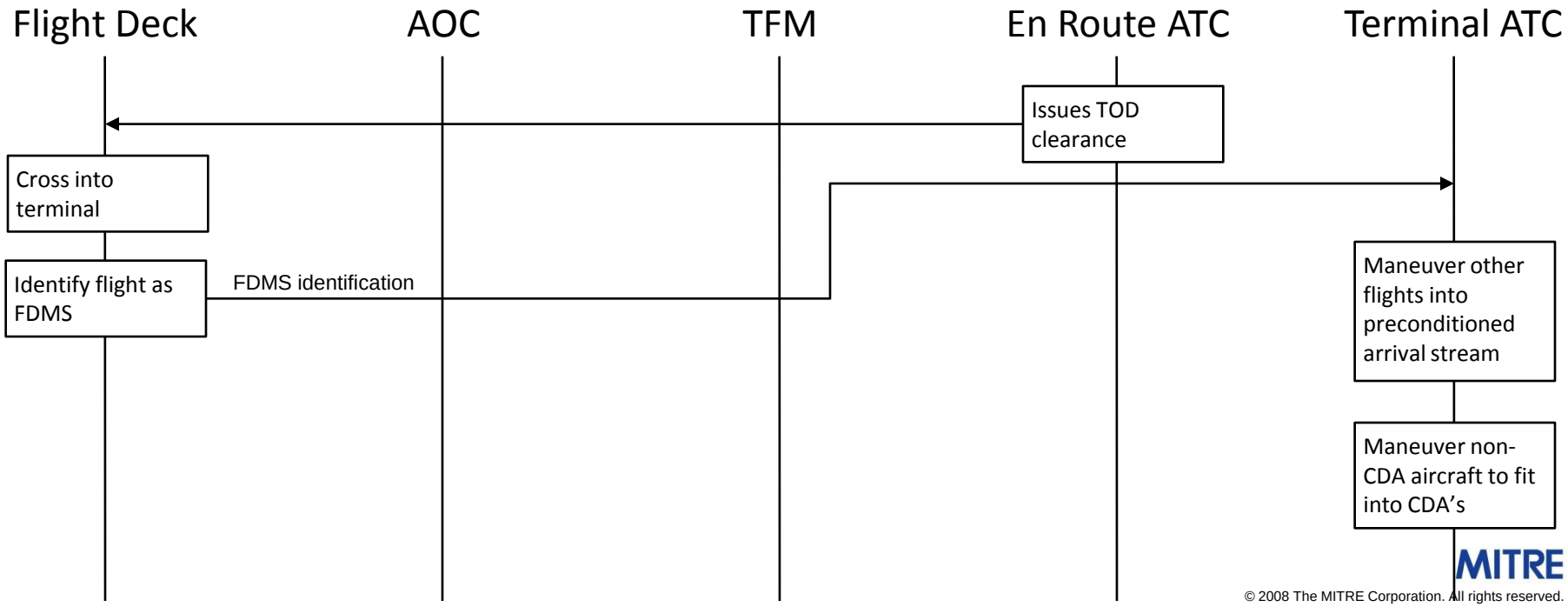
En Route – Freeze





EMSP Step I

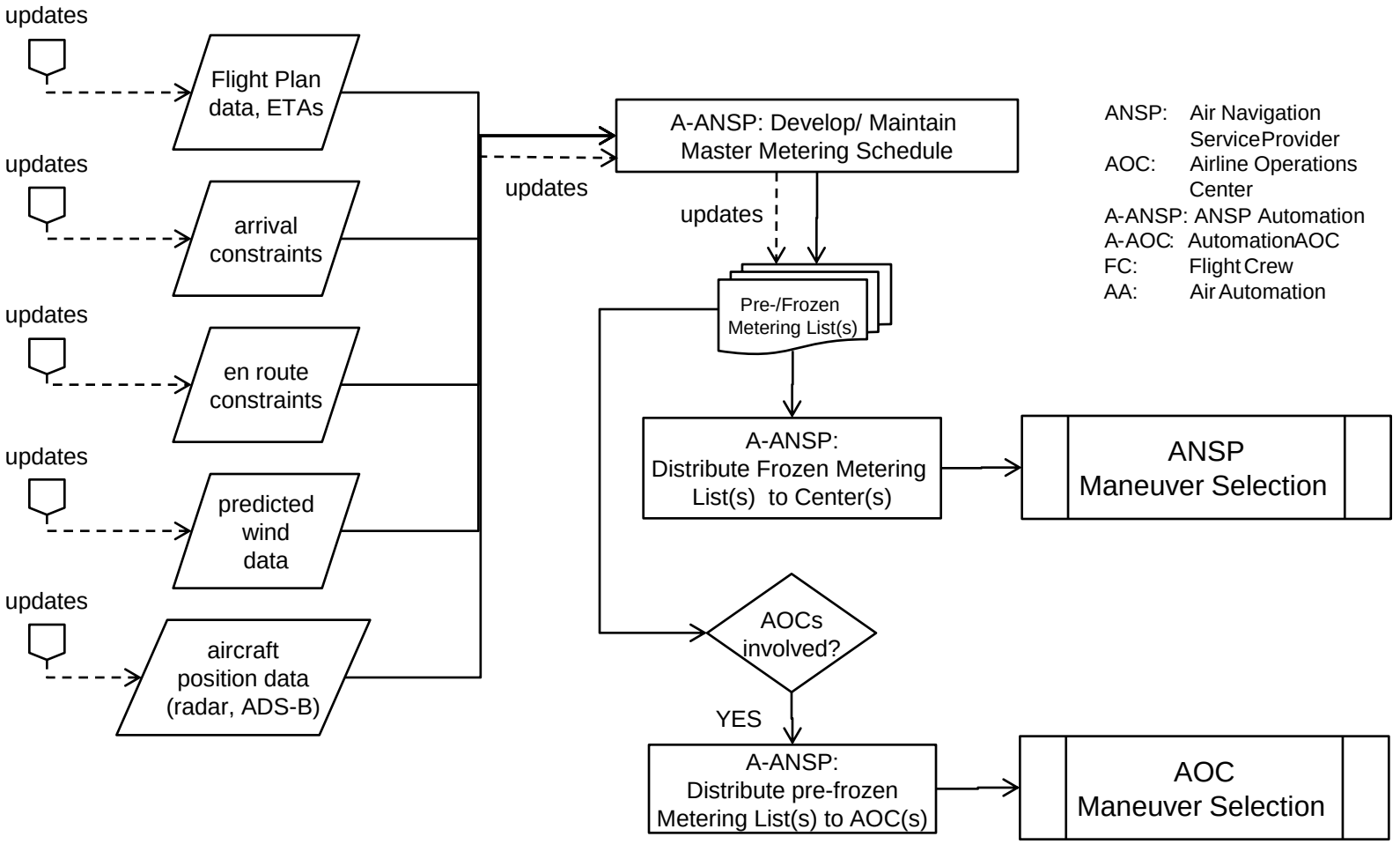
Descent



EMSP

FLOW CHARTS

Create and Distribute Metering Schedule



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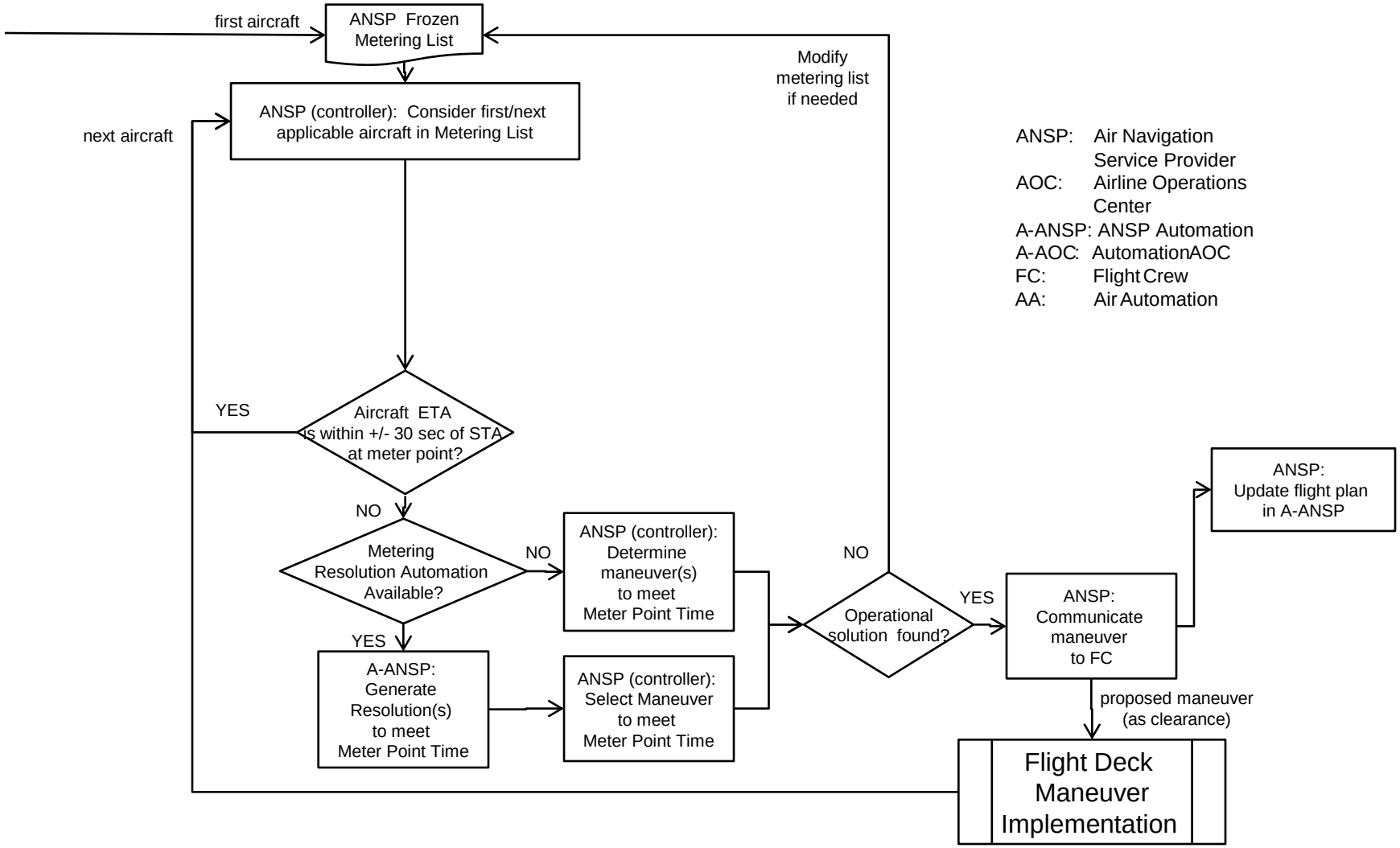
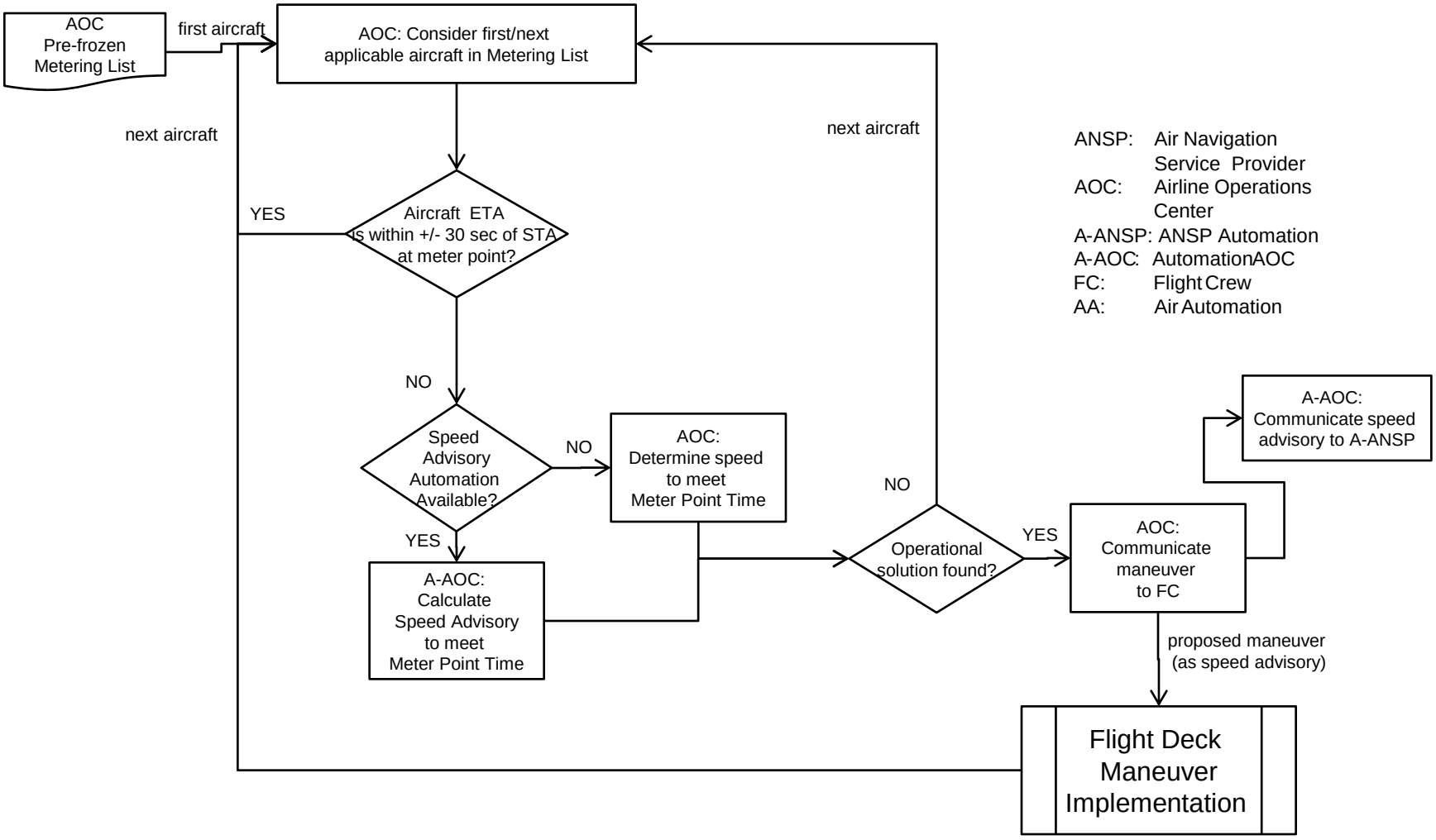
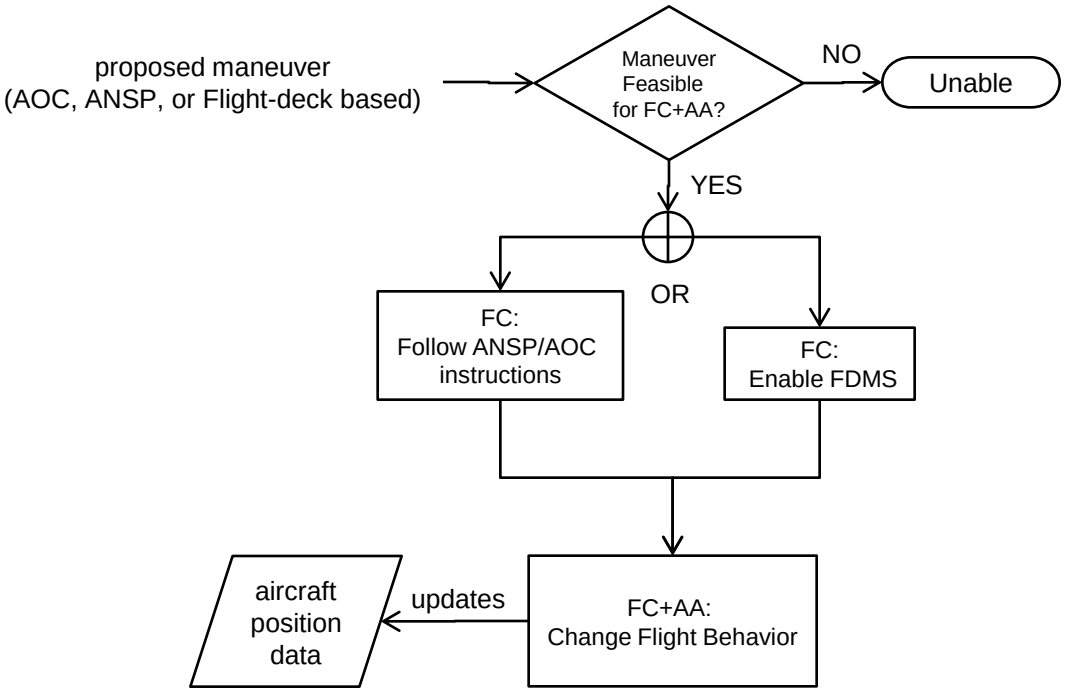
ANSP Maneuver Selection



AOC Maneuver Selection



Flight Deck Maneuver Implementation



ANSP: Air Navigation Service Provider
AOC: Airline Operations Center
A-ANSP: ANSP Automation
A-AOC: Automation AOC
FC: Flight Crew
AA: Air Automation